

Math in CTE Discussion

Iowa Department of Education

Unless otherwise noted, the slides contained in this presentation are borrowed from National Center for Career and Technical Education publications for purposes of this discussion only.



Math-in-CTE is a State-led Initiative that Can Help Schools Meet Their Perkins and NCLB Mathematics Requirements.

Currently:

- A significant number of schools are not meeting their Perkins 1S2 Academic attainment-mathematics required State Negotiated Performance Level.
- A significant number of schools are not meeting their goals of academic achievement—aligned to NCLB academic content and achievement standards for mathematics.

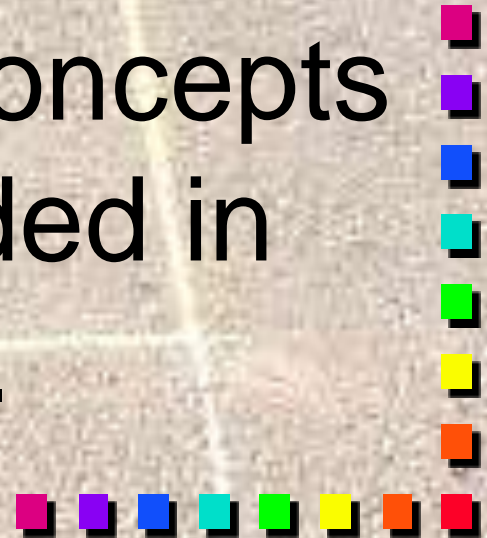


Iowa High School Mathematics Model Core Curriculum

Recent results of national and international tests show that the United States is facing a crisis in mathematics education. American high school students score near the bottom on the international TIMSS and PISA tests. Analysis of this poor performance shows that the U.S. mathematics curriculum is **“a mile wide and an inch deep,” trying to cover too many topics in not enough depth.** All Iowa high school students must be better prepared in mathematics to successfully compete in the technology-rich, information-dense, global society. To achieve this we must redesign our mathematics curriculum so that it is focused on providing deep understanding of important mathematics.

From: Mathematics Model Core Curriculum; Iowa Department of Education

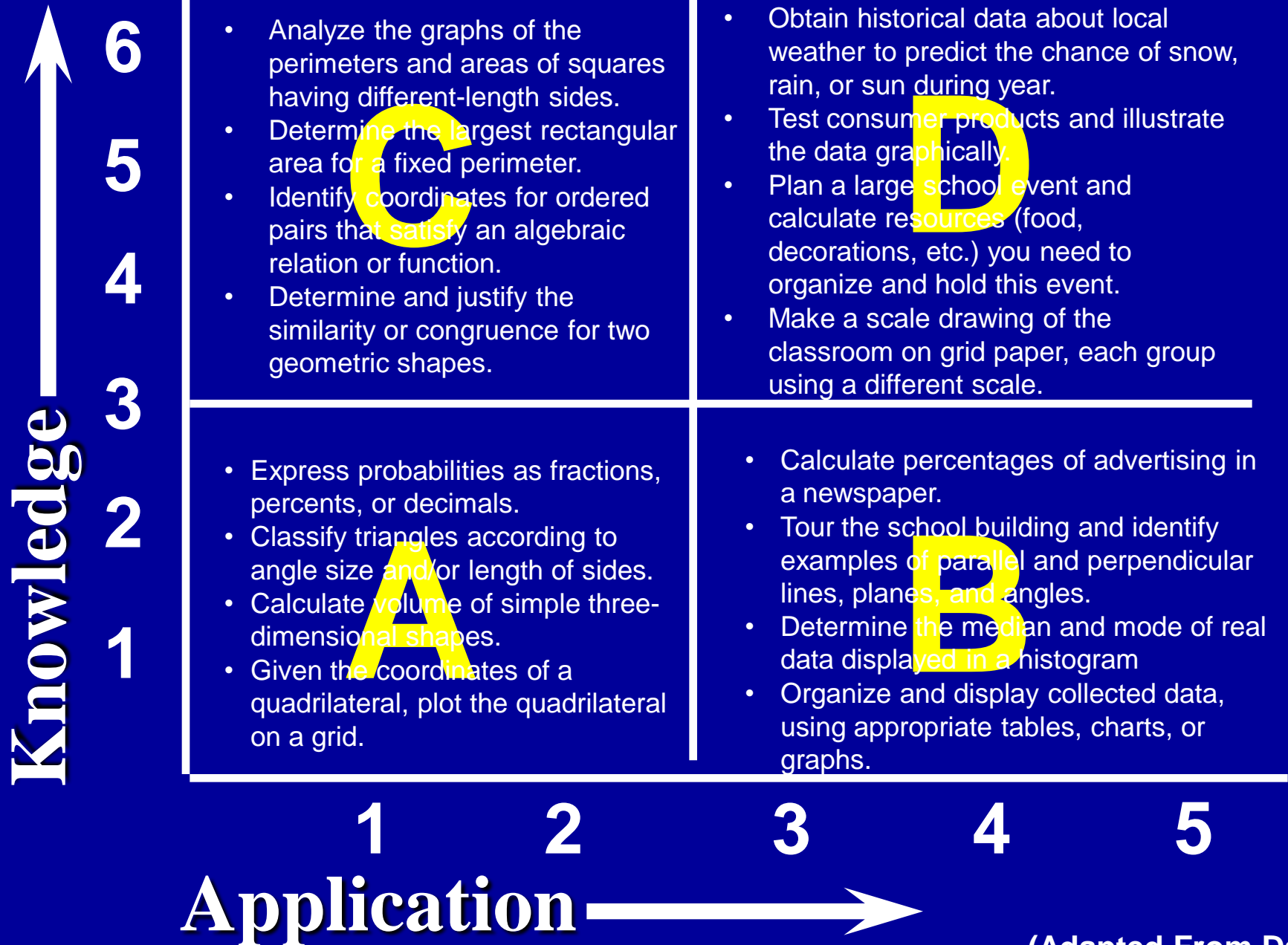
The Math-in-CTE model offers the opportunity to teach math concepts outside of traditional math classes in a context-rich environment by explicitly teaching mathematics concepts that are already embedded in occupational curriculum.



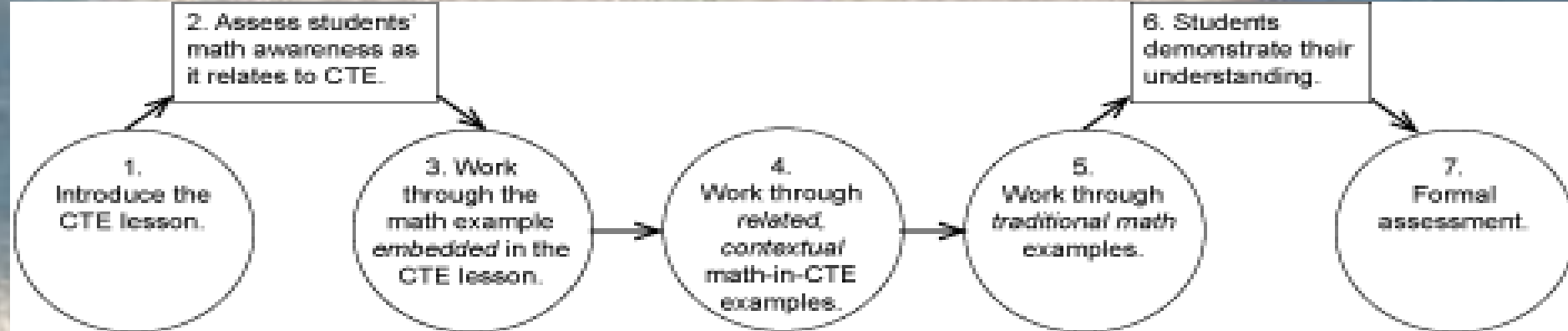
Math-in-CTE Is Compatible with School Improvement Initiatives



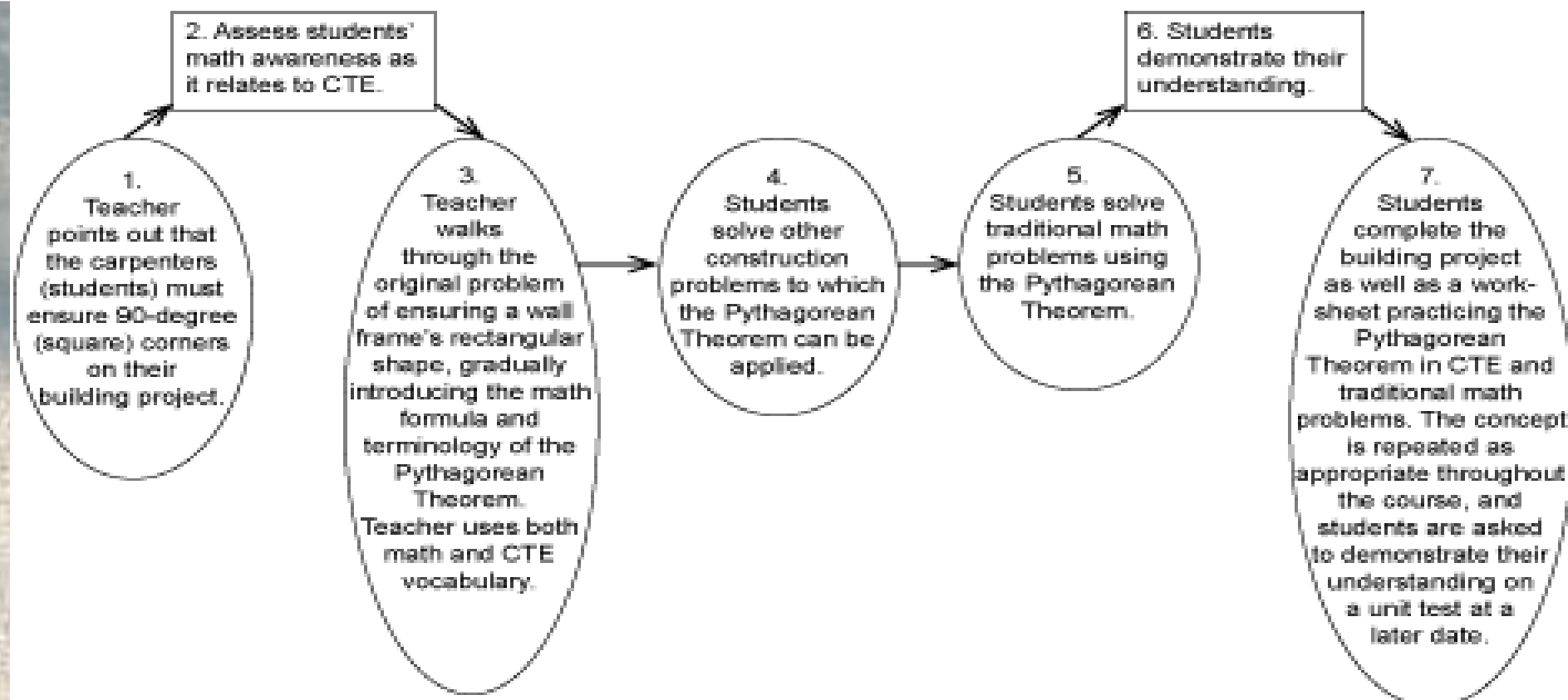
Rigor/Relevance Framework



(Adapted From Daggett)



The Seven Elements: Components of a Math-Enhanced Lesson.



Mathematics in the **Model Core Curriculum** is built around and focused on:

- Teaching for Understanding
- Problem-based instructional tasks
- Distributed practice that is meaningful and purposeful
- Mathematical modeling
- Deep conceptual and procedural knowledge
- Effective use of technology
- Integrated content
- **A perfect parallel with the Math-in-CTE Model!**



Every Student Counts

Teaching for Understanding

■ Iowa's mathematics educators are taking what we know from research and putting it into practice to improve K-12 student achievement. Iowa's ESC project has three fundamental research-based components:

- Teaching for understanding
- Problem-based instructional tasks
- Meaningful distributed practice.

■ A perfect parallel with the Math-in-CTE Model!



Why Focus on the Math in CTE Model?

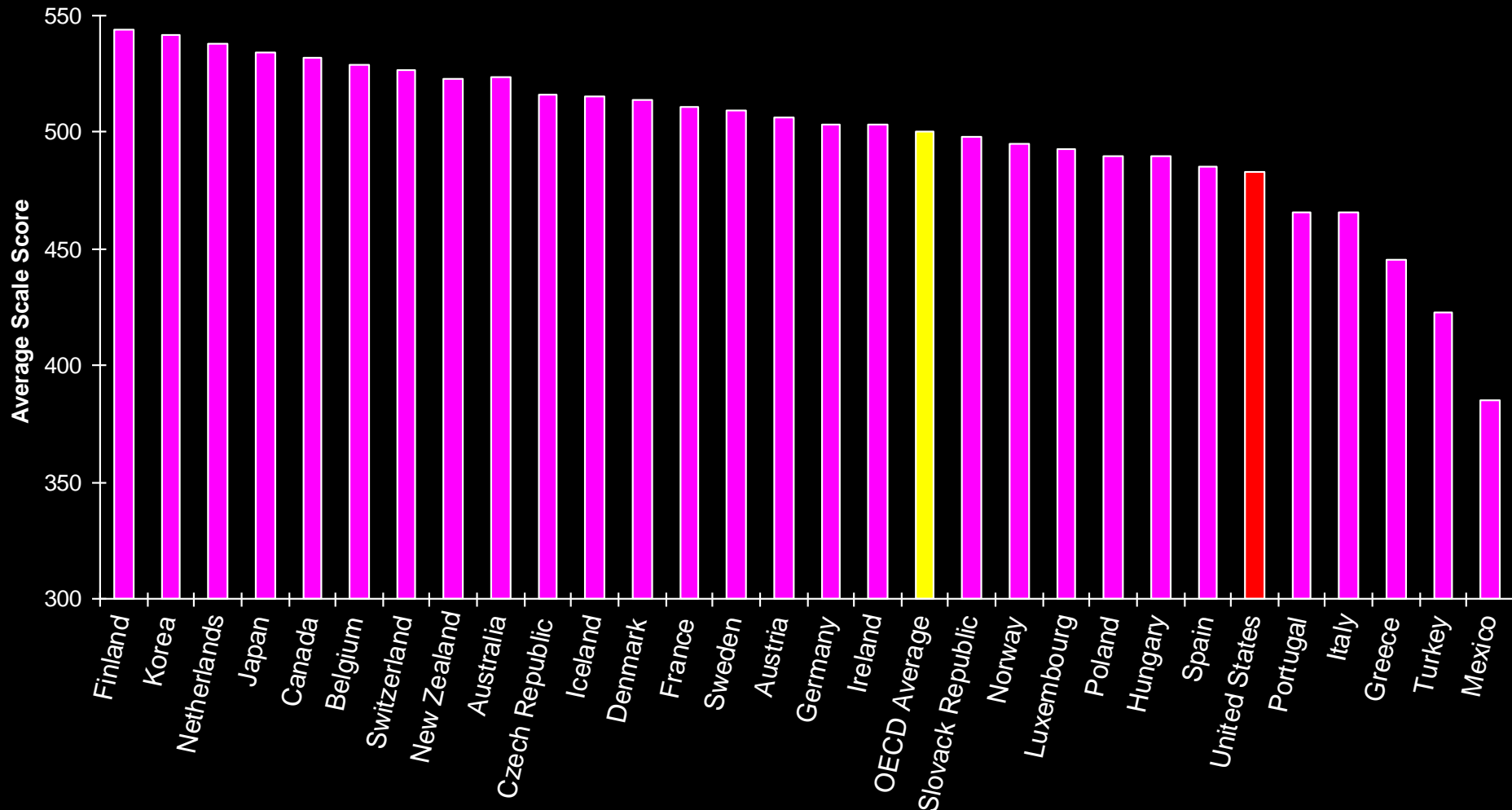
- CTE provides a math-rich context
- CTE curriculum/pedagogies do not currently systematically emphasize math skill development.



Data Documents the Need



2003: U.S. Ranked 24th out of 29 OECD Countries in Mathematics



The Problem: Youth Math Performance

While the number of 17-year-old students taking advanced math classes has increased (17% studying calculus and 53% studying second-year algebra), it is unclear why that trend has not resulted in higher average math scores over all.

National Assessment of Educational Progress

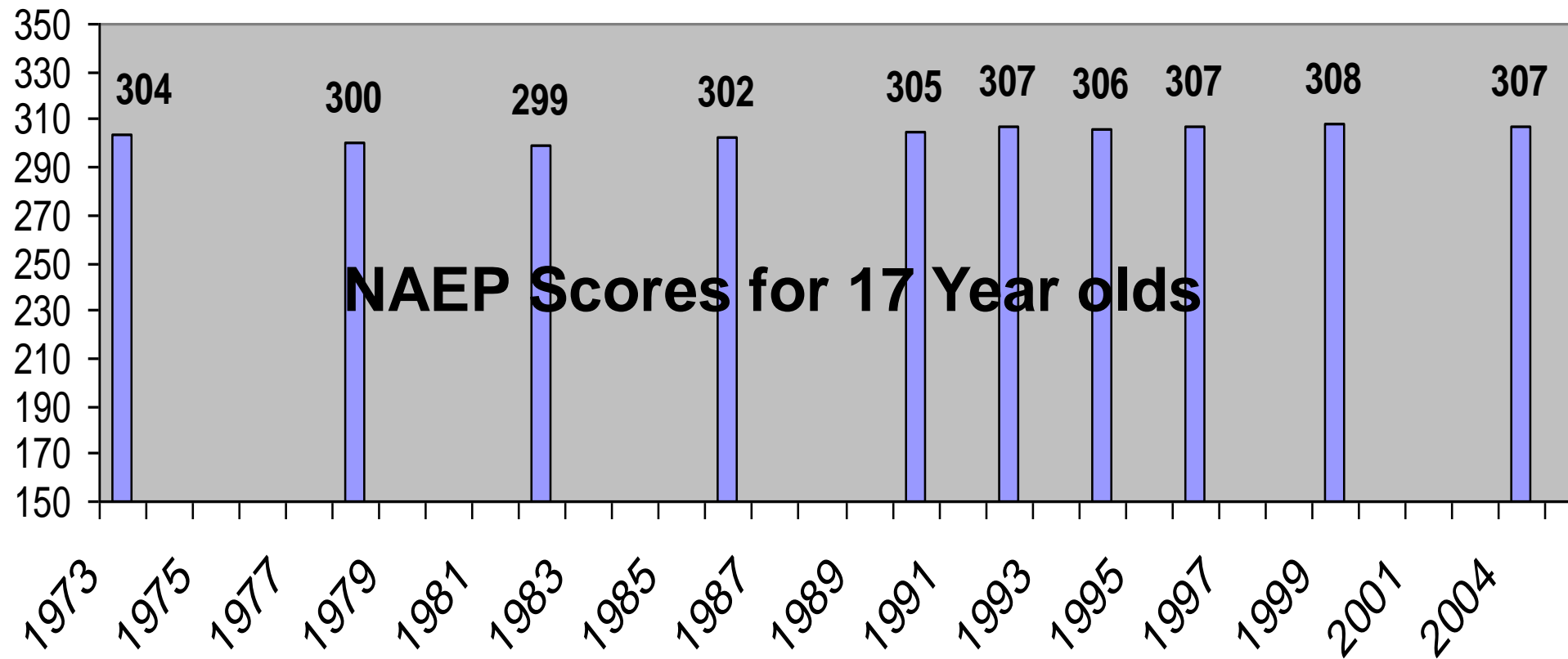


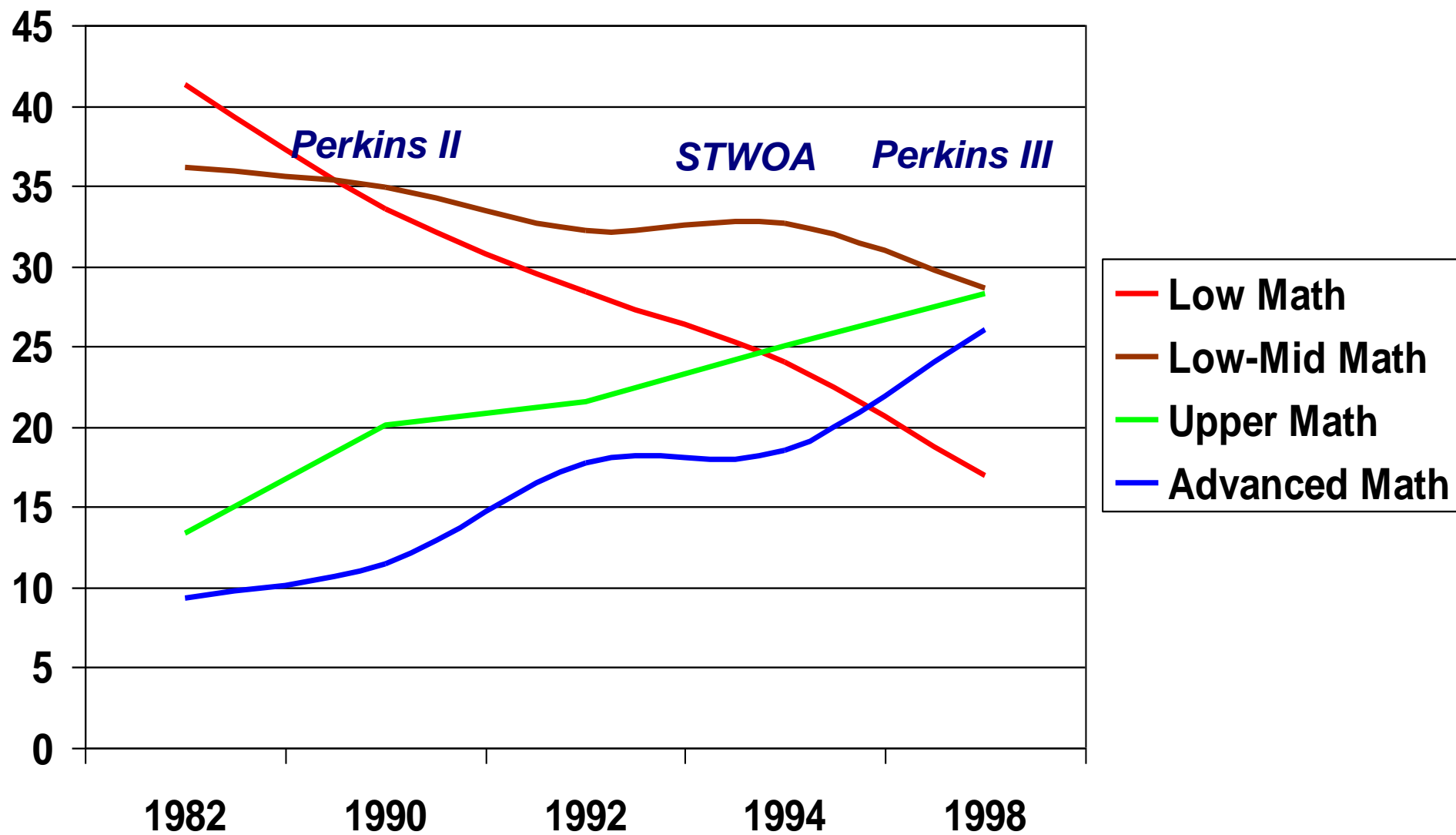
Figure 18. Changes in eighth-grade NAEP mathematics average scores between 2005 and 2007



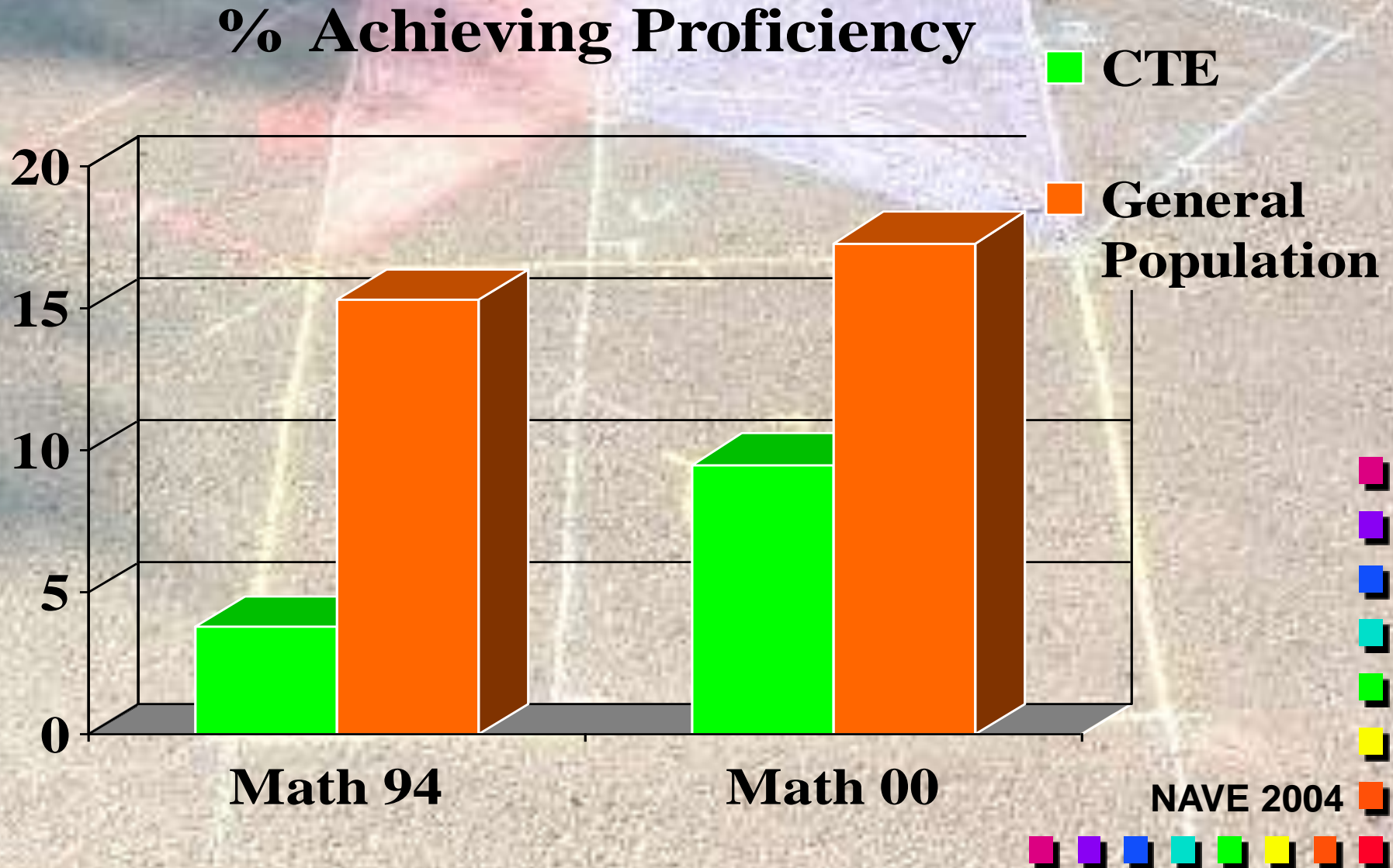
¹ Department of Defense Education Activity (overseas and domestic schools).

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2005 and 2007 Mathematics Assessments.

Trends in Math Taking by CTE Concentrators - 1982-1998



But CTE students still lag behind



Math-in-CTE Can Help



Why Focus on Math in CTE?

- **Students earn more credits in CTE than in math or science.**
- **97% take at least one course.**
- **Nearly half earn at least 3 credits (1½ units) in an occupational pathway.**
- **One-quarter are “concentrators” (taking 2 units).**

NAVE 2004



The Carl D. Perkins Career and Technical Education Improvement Act of 2006

(originally authorized in 1984)

- Focus has shifted to require that CTE programs emphasize career and technical courses that are academically rigorous and up-to-date with the needs of business and industry.
- Integrating academics into CTE is required by Perkins IV.

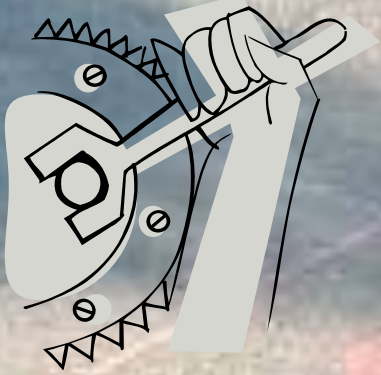


Rigorous Academic AND Career Development

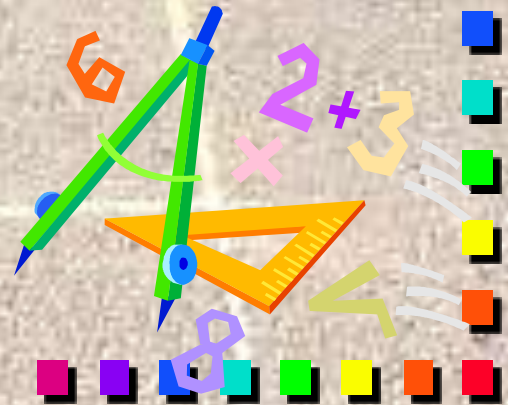
Why?

- **Perkins accountability compels it**
- **NCLB requires it**
- **Industry demands it**
- **Math is an important academic foundation skill necessary to prepare students for lifelong learning.**
- **Workers need it - the average worker changes jobs 10 times by age 40.**





Math-in-CTE: An “evidenced based approach” to improving academic performance of CTE students.



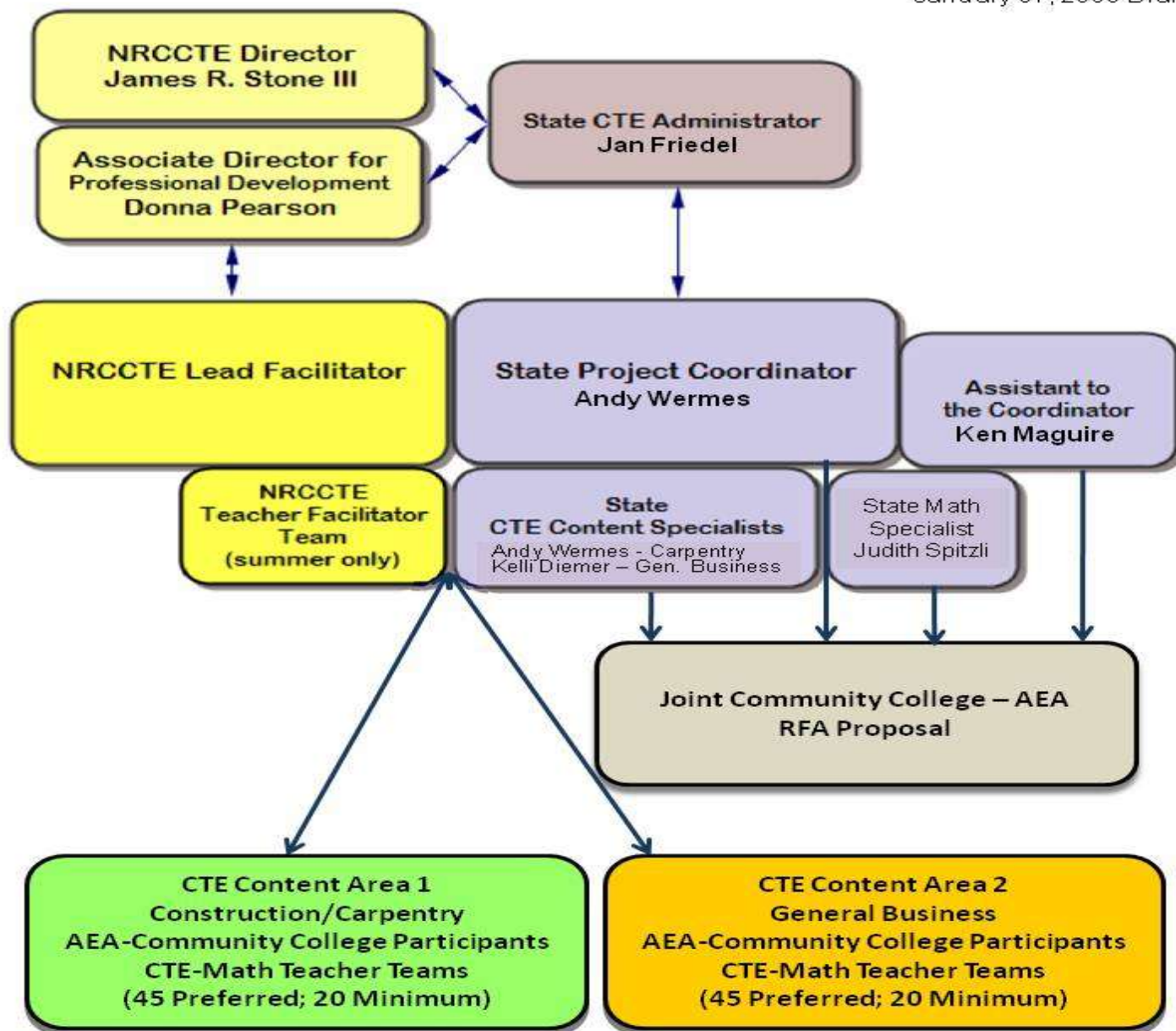
The Math-in-CTE Model Structure



Math-in-CTE

Technical Assistance Leadership Team

January 07, 2008 Draft



The Math-in-CTE Process

- Building Academic Skills in Context:
Testing the Value of Enhanced Math
Learning in CTE (Final Study Report)

■ <http://www.nccte.org/publications/infosynthesis/r%26dreport/MathLearningFinalStudy.pdf>



Math in CTE Study

Working Hypothesis

High school students experiencing a math-enhanced CTE curriculum will develop a deeper and more sustained understanding of mathematical concepts than those students who participate in the traditional CTE curriculum.



Key Questions of the Study

- Does enhancing the CTE curriculum with math increase math skills of CTE students?
- Can we infuse enough math into CTE curricula to meaningfully enhance the academic skills of CTE participants (Perkins IV Core Indicator)
- . . . Without reducing technical skill development
- What works?



The Math-in-CTE Model:

Core Principles

- Develop and sustain a community of practice
- Begin with the CTE curriculum and not with the math curriculum
- Understand math as essential workplace skill
- Maximize the math in CTE curricula
- CTE teachers are teachers of “math-in-CTE”
NOT math teachers
- Note: Math in CTE **does not** take the place of math courses.



Math-in-CTE

Professional Development

- The integration of academics and CTE was the second priority area among a field of 49 possibilities surveyed for the last three years.

From:

A Summary Report on the Third Annual Survey on Priorities in CTE Professional Development.

Pivnichny, T. G., Wichowski, C. P. & Heberley, G. (2007)

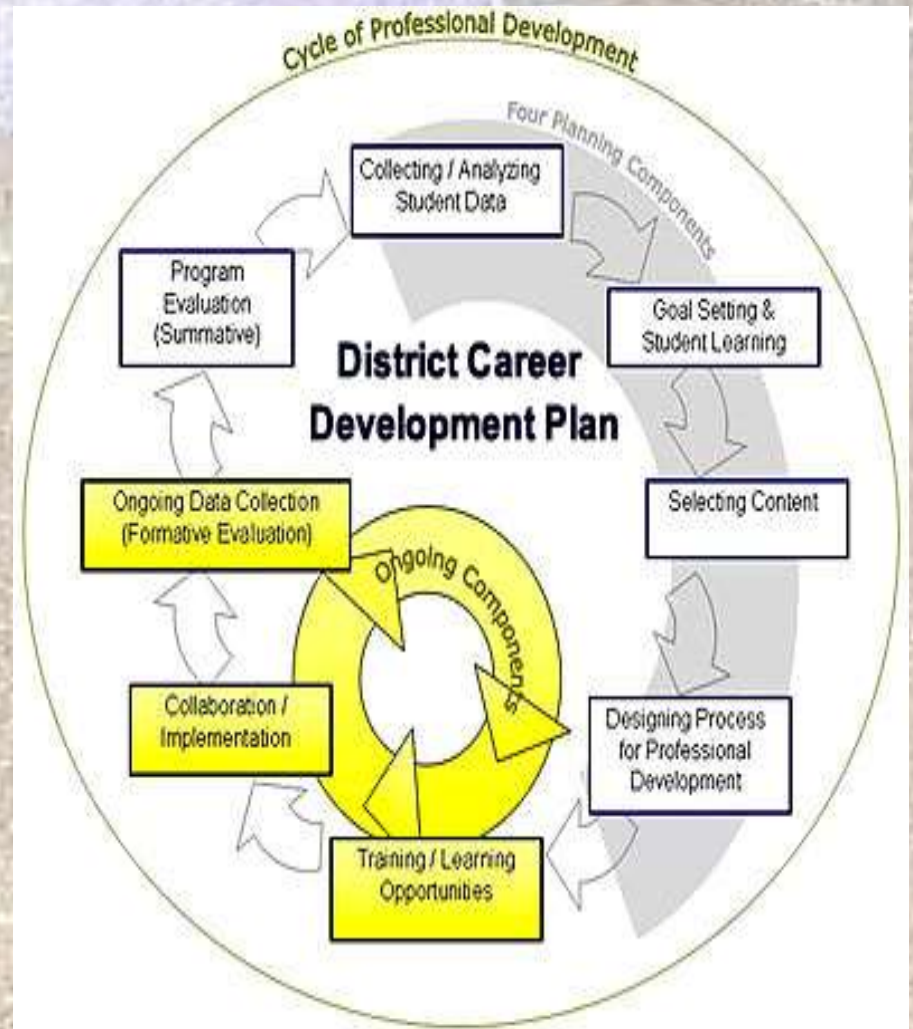
Association for Professional Development in Career and Technical Education, a subgroup Division of the Association for Career and Technical Education.



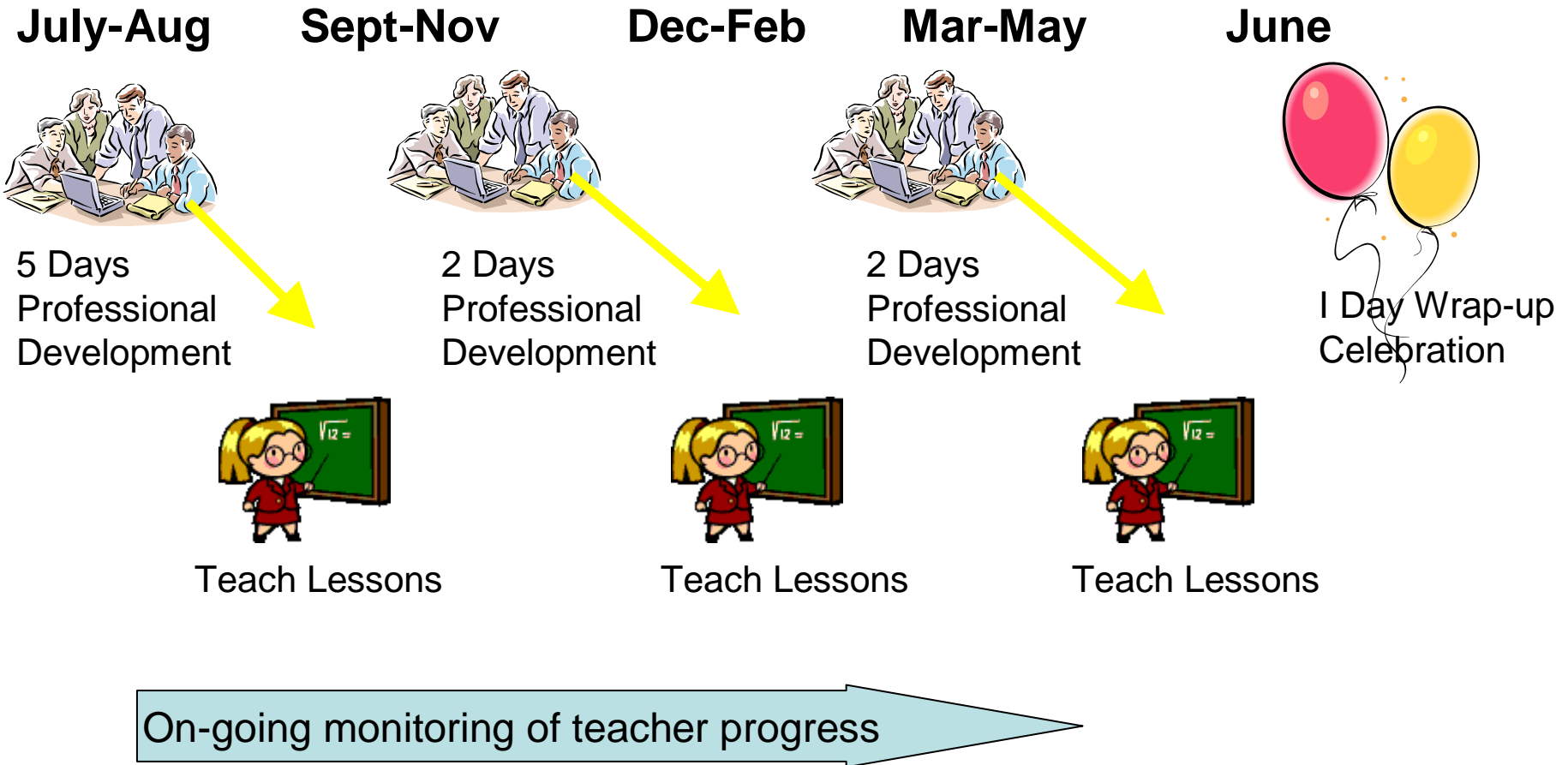
Professional Development – “Best Practices”

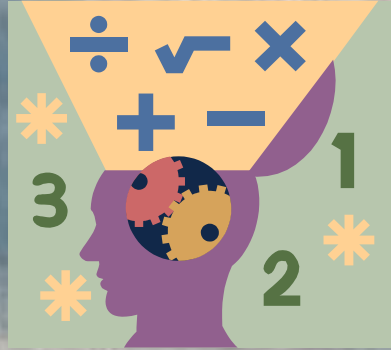
Using the Iowa Professional Development Model

- Utilizing national and international data, the Math-in-CTE model follows the foundations and structure presented in The Iowa Professional Development Model.
- It's data driven – using scientific data.
- Learning is at the center.
- It's an ongoing cycle.
- Formative and summative evaluation.
- Collaboration
- Coaching is built-in for sustainability.



Math-in-CTE Professional Development “Year-at-a-Glance”





The Math-in-CTE Model:

Professional Development

- Professional Development Workshops
 - Curriculum mapping (math/CTE nexus)
 - Scope & Sequence (map the year)
 - Development of math-enhanced lessons
 - On-going math support/coaching
 - Teaching the Lessons (year-long)

The Math-in-CTE model aligns with the Iowa Professional Development Model.



Curriculum Maps

- Begin with CTE Content
- Look for places where math is part of the CTE content (V-Tecs, AYES, MarkED, state guides, last year's maps)
- Create “map” for the school year
- Align map with planned curriculum for the year (scope & sequence)



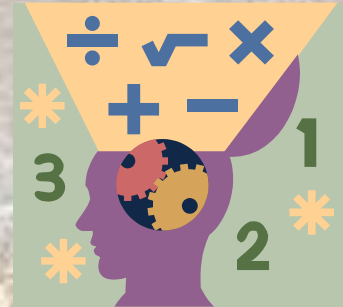
TIME	CTE CONCEPT	MATH CONCEPT	MATH-IN-CTE LESSON	MATH STANDARD	MATH PARTNER MEETING DATE
WEEK 1 Aug. 1	Marketing and DECA Orientation	NA	NA	NA	NA
WEEK 2 Aug. 23	DECA Orientation	General Overview of the Math-in-CTE Project	NA	NA	NA
WEEK 3 Aug. 30 (Officer Elections)	Sales Unit	Introduction to the 7 Math Concepts	Consent Forms, Student Survey, and Math Pre Test	NA	Sept. 2
WEEK 4 Sept. 7 (TSLP begins)	Sales Unit	Ratio/Percentages	#1 – To Market, To Market; Lesson #25	Standards 1, 6	Sept. 9
WEEK 5 Sept. 13	Sales Unit	Graphing/ Predictions Algebraic Expressions & Equations, Pattern Recognition, Functions, Data Representation	#4 - What Product to Sell	Standards 1, 2, 3, 5, 6	Sept. 16

Sample Scope & Sequence

The Math in CTE Pedagogy:

“7 elements” of a Math-Enhanced Lesson

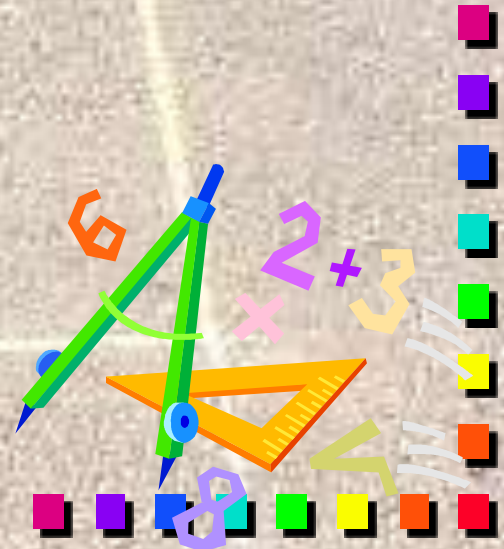
1. Introduce the CTE lesson
2. Assess students' math awareness
3. Work through the *embedded* example
4. Work through *related, contextual* examples
5. Work through *traditional math* examples
6. Students demonstrate understanding
7. Formal assessment



Element 1:

Introduce the CTE lesson

- Explain the CTE lesson.
- Identify, discuss, point out, pull out the math embedded in the CTE lesson.



Element 2:

Assess students' math awareness

- Begin “bridging” between the CTE and math.
- Introduce math vocabulary *through* the math ***embedded*** in the CTE.
- Use methods and techniques to assess the whole class.



Element 3: Work through the math example *embedded* in the CTE lesson

- Work through the steps or processes of the *embedded* math example.
- Introduce math “procedures”
- Continue to bridge the CTE and math vocabulary.



Element 4: Work through *related math-in-CTE* examples

Using the same embedded math concept:

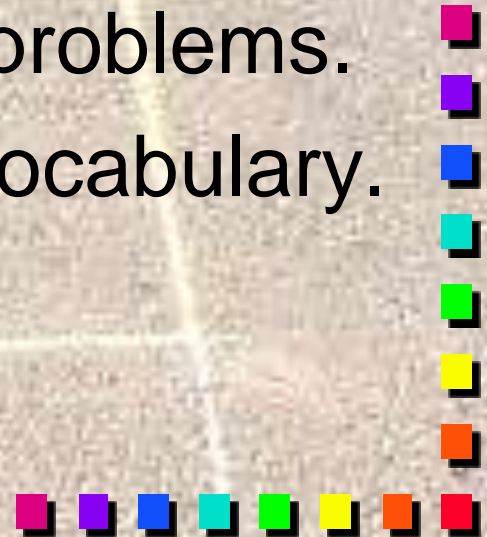
- Work through **similar problems** in the same occupational context.
- Use examples of varying levels of difficulty; order from basic to advanced.
- Continue to bridge CTE and math vocabulary.
- Check for understanding.



Element 5: Work through *traditional math* examples

Using the same embedded math concept:

- Work from applied to **abstract** problems.
- Work through examples as they may appear on standardized tests.
- Move from basic to **advanced** problems.
- Continue to bridge CTE-math vocabulary.
- Check for understanding.



Element 6: Students demonstrate understanding

- Provide students with opportunities to demonstrate their understanding of the math concepts embedded in the CTE.
- Connect the math back to CTE context.
- Conclude the lesson with CTE.



Element 7: Formal Assessment

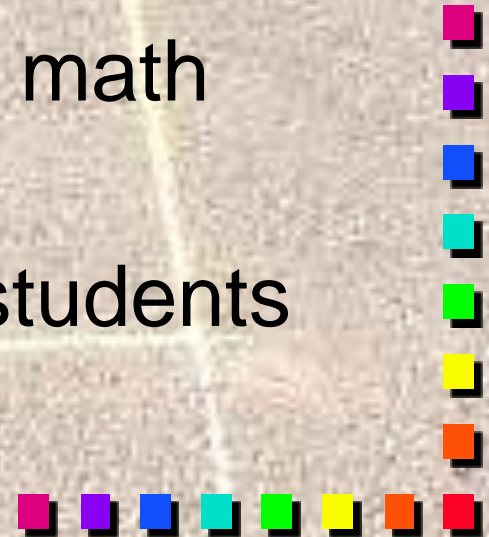
■ Include math questions in formal assessments, for example:

- CTE unit exams
- CTE project assessments



Final thoughts: Math-in-CTE

- A powerful, ***evidence based strategy*** for improving math skills of students;
- ***A*** way but not ***THE*** way to help high school students master math
- ***Not a substitute*** for traditional math courses
- ***Lab*** for mastering what many students learn but don't understand



Math-in-CTE

Makes it **All Work!**

The Math-in-CTE research-based approach to professional development and curriculum integration meets what we are all trying to achieve – improved student learning. But most importantly, it leads to improved math skills necessary for student success in the workplace...





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- PK-12 Education
- PK-12 Finance & Data
- Community Colleges & Workforce Preparation
- Adult Literacy
- Career & Technical Education
 - Career & Technical Programs
 - Overview
 - Career Planning
 - Career & Technical Education
 - Standards & Benchmarks
 - Entrepreneurship
 - Math in CTE
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Math in CTE

The Division of Community Colleges and Workforce Preparation, Bureau of Community Colleges and Career and Technical Education in partnership with Pre-K – 12 Education Division is moving forward with plans to implement a model to integrate math into Iowa's career and technical education (CTE) programs at the secondary and postsecondary levels. The model was researched, developed, and studied by the National Research Center for Career and Technical Education (NRCCTE). The Final Report on the Math-in-CTE study is available at: [NRCCTE](#)

The original model was limited to secondary school CTE program students. The implementation of the model in Iowa includes a proposal to replicate the secondary model, and also to expand the application of that model to community college CTE program students. Perkins IV requires rigorous academic integration into CTE programs. Implementing the model in community college CTE programs makes sense because the community colleges not only deliver postsecondary CTE training, but also a significant segment of secondary CTE training.

Educators and learning communities of CTE and math partner instructors participated in a pre-conference session at the Iowa Association of Career and Technical Education held in Ames on November 8, 2007. The files below are the presentation and handouts from that workshop.

- [Seven Elements of Math Enhanced CTE Lesson Plan](#)
- [Core Principles in Math CTE Model](#)
- [Curriculum Map Template](#)
- [Making Math Work](#)
- [Math CTE Lesson Plan Template](#)
- [Math in CTE Automotive Lesson Example](#)
- [Math in CTE Professional Development - A Year at a Glance](#)
- [Math in CTE Research Study](#)
- [Math in CTE Sample Health Lesson Plan](#)

Next Steps:

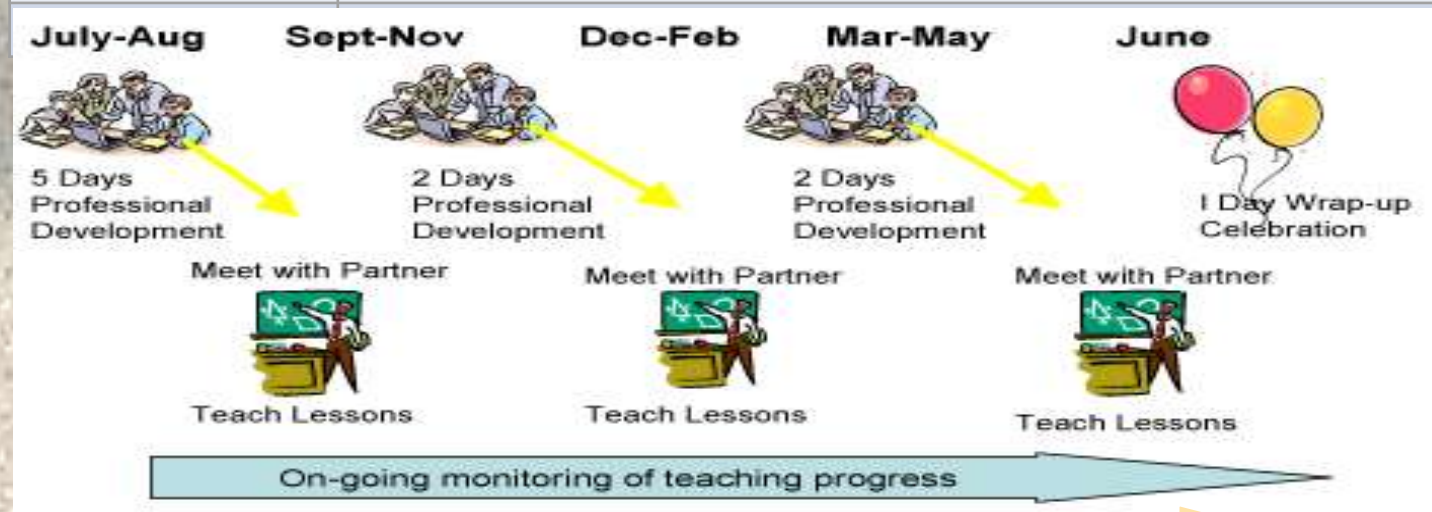
- Work on our partnership RFA's



Math-in-CTE Timeline

January 07, 2008 Draft

By Date	Achieved
Jan 10 th	Receive participation commitment from merged areas.
Jan 18 th	2 CTE areas identified and districts notified
Feb 11 th – 15 th	RFA Quadrant Meetings
Feb 29 th	RFA Due
Feb 29 th	Identify/Register Teacher Teams
April 21 st – 23 rd	ICN Planning meeting w/ State Leadership Team, Community Colleges, AEA Directors, and merged area participants.
June 9 th – 13 th	5-Day Initial Professional Development Training Conference
Fall '08	2-Day Professional Development Meeting
Winter '09	2-Day Professional Development Meeting
End of School Year '09	1-Day Professional Development Meeting



'09+ Ongoing Model Core, AIW, and other academic, CTE, and Perkins meetings and activities to sustain the Math-in-CTE initiative